

3D structured composites of graphene and graphene quantum dots for tri-functional electrocatalyst

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3D structured composites of graphene and graphene quantum dots (GQDs) have been fabricated through one-step hydrothermal process and we demonstrated their applications as tri-functional electrocatalyst. The all carbon-based hybrid nanomaterial possesses superior simultaneous trifunctional electrocatalytic activity toward oxygen reduction reaction (ORR), oxygen evolution reaction (OER) and hydrogen evolution reaction (HER), even closed to the available commercial Pt/C and IrO₂/C. The composites also exhibit an excellent long-term stability and good tolerance. The integration of B-GQDs and GH induces synergistic effect of high electrical conductivity as well as large surface area of graphene hydrogel and abundance of catalytically active sites on B-GQDs surface, thus leading to enhance catalytic activities. Interestingly, various boron bonding compositions have been found to be significant influence on multi catalytic reactions derived from the composite in which BCO₂ species can be served as OER and HER, while BC₃ structures can catalyze the reduction of oxygen.